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TEST FORM

CALIFORNIA DESERT PROJECT STANDARD UNIT RECORD FOR DESERT TORTOISE SURVEY

[1] RECORD TYPE	W	2
[2] STATE	N	V
[3] DISTRICT	L	V
[4] PLANNING UNIT	0	2
[5] SITE NUMBER	~	5
[6] COUNTY	L	I
[7] ACTION [A = ADD C = CHANGE D = DELETE]		

[8] SECTION I — GENERAL SITE DESCRIPTION

[9] DATE OF SURVEY YR./MO./DAY	[10] HOUR	[11] RECORDER	[12] WINDSPEED	WEATHER CONDITIONS [13] TEMP	WEATHER CONDITIONS [14] CLOUD COV	[15] ASPECT	[16] SLOPE % AVG.
80/4/11	1945 Pst	A. Karl	15 mph	18.6°C	/	W	5.0

[17] GEOMORPHOLOGY	[18] ELEVATION	[19] TEXTURE TYPE	[20] VEGETAL ASPECT	[21] HABITAT CONDITION	TRANSECT [22] LENGTH (FEET)	TRANSECT [23] WIDTH
Slightly rolling bajada	2800'	mod.-soft, densely gravelly	open	Graded dirt rd. near	7920'	10 m

[8] SECTION II — LOCATION DATA Light use at area. Also on old dirt rd. Well removed area

[9] TOPOGRAPHIC QUAD SCALE	NAME	SITE NAME
7.5'	Wildcat Wash N.W	Kane Springs Wash

CADASTRAL GRID LOCATION [10] TOWNSHIP	[11] RANGE	[12] SECTION	[13] SUBDIVISION	UTM GRID LOCATION [14] ZONE	[15] NORTHING	[16] EASTING
11S	63E	14	N			

[8] SECTION III — BURROW AND SCAT DATA

	BURROWS							SCATS		
[9] LINE #	[10] LENGTH	[11] WIDTH	[12] HEIGHT	[13] SOIL COVER AT ENTRY	[14] CONDITION	[15] LOCATION	[16] SCATS	[17] SIZE	[18] CONDITION	[19] LOCATION
01	290	193	22	33	4	2	2			
02	91	163	55	56	3	2	2			
03	515	278	5–	68	3	1-3 m side and bottom wash	2			
04	~228	240	~30	~40	3,6	2-bank	2			
05	Plus one pallet, caved-in burrow									
06										
07										
08										
09										
10										
11										
12										
13										
14										
15										

COMMENTS: Photo - Roll 10, #20
In today's transects, the remainder of last year's annuals isn't nearly as dense (often remain bent) as this year's.

QL
666
.C584
K37
1983

(8) SECTION IV — LIVE TORTOISE, SHELLS, SHELL PARTS DATA

(9) LINE #	(10) TYPE REPORT (L-or-S)	(11) SEX	(12) SIZE	(13) LOCATION	(14) ACTIVITY	(15) CONDITION	(16) AGING
01							
02							
03							
04							
05							
06							
07							
08							
09							
10							
11							
12							

(8) SECTION V — TRACKS DATA

(9) LINE #	(10) WIDTH	(11) SEX	(12) LOCATION	(13) AGE	COURTSHIP RINGS	
					(14) LENGTH	(15) WIDTH
01						
02						
03						
04						
05						
06						
07						
08						

REMARKS: A few canid digs.

Veg. *Larrea*, *Ambros.* & slight diversity. Mod. dense Understory has *Festuca* (predom. except under shrubs & in washes where *Bromus* is often predom. & dense), *Bromus rubens*, some diversity (mustard, *Crypt.*, *Pectocarya*, plus).

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1983

The Distribution and Relative Densities of the Desert Tortoise, *Gopherus agassizi*, in Clark County, Nevada

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ABSTRACT

Two-hundred and four strip transects were walked in Clark County, Nevada, to determine the relative densities and distribution of the desert tortoise, Gopherus agassizi. Evidence of tortoises extended to the southern and eastern borders of the state, west to Nye County, and north to Lincoln County. Tortoise density estimates are 0-10 tortoises/mi^2 for 26 percent of the surveyed area, 1-10 tortoises/mi^2 for 6 percent, 11-50 tortoises/mi^2 for 54 percent, 11-100 tortoises/mi^2 for 2 percent, 51-100 tortoises/mi^2 for 8 percent, 51-150 tortoises/mi^2 for 1 percent, and 101-150 tortoises/mi^2 for 3 percent. Total desert tortoise habitat in Clark County is estimated to comprise 4900 mi^2. Nine areas are identified as high density areas and implications regarding the viability of the tortoise in Clark County are discussed in reference to these areas. In addition, tentative suggestions are offered regarding habitat associations of the desert tortoise.

INTRODUCTION

The Bureau of Land Management (BLM) is legally required to provide maximum protection for federally and state listed species and their associated habitats in order to insure the continued existence of such species. In order to minimize the potential for official listing and thus broaden management options, potentially threatened species are designated as "sensitive" by the BLM State Director, in cooperation with the Director of the State Wildlife Agency. This insures that the designated species will receive special consideration in the BLM's decision-making processes. The desert tortoise, Gopherus agassizi, is categorized as "sensitive" in Nevada. It also receives protection from the Nevada Department of Wildlife Resources.

To assist in the preparation of Grazing Environmental Statements (GES) for Clark and Nye counties and to augment the Caliente Management Framework Plan for Lincoln County, data were collected on the desert tortoise in an effort to determine its status in Nevada. Demographic data were collected from two populations in Clark County (Karl, 1979a, b) and one in Nye County (Karl, 1981a) and potential desert tortoise habitat was surveyed in Lincoln, Nye (Karl, 1983a), and Clark counties to determine the distribution and relative densities of the desert tortoise in Nevada. This report discusses the results of the survey in Clark County.

METHODS AND MATERIALS

Two-hundred and four strip transects were walked in Fall, 1979. General areas to be surveyed were suggested by the BLM; the criteria included public lands, below 5000 ft in elevation. I selected actual transect sites on the basis of their proximity to adjacent transects, avoidance of agriculture or urbanization and access. The resulting transect density was 2 transects/township, with an intertransect spacing of approximately four miles. (The exception to this was on the Piute Valley [Karl, 1979a] and Sheep Mountain [Karl, 1979b] study plots, where 3 and 2 transects, respectively, were walked in 1 mi^2 to assist in the formulation of a sign-density index [see below].) Additionally, only four transects were located within 0.5 mi of a paved road due to Nicholson's (1978) finding that there is a significant decrease in tortoise densities adjacent to roads, up to a lateral distance of 0.5 mi. No transect was initiated within 0.3 mi of a graded dirt road.

The transect method was developed by Berry et al. (1979). Transects were 1.5 mi in length, approximately 10 yds wide and comprised an equilateral triangle. An effort was made to sample only homogeneous habitats in order to minimize errors due to heterogeneity (Berry,et al., 1979). However, because a compass heading was followed, this was occasionally impossible. All indications (sign) of tortoises (e.g. burrows, scat, tortoises, skeletal remains, tracks, eggs) encountered in the transect were recorded on forms developed by Berry et al. (1979) (Appendix IV).

The amount of tortoise sign encountered during a transect was used to estimate the tortoise density at that site. Because of the seasonal and daily variation in tortoise activity which coincided with the surveys, two categories of sign were used to estimate tortoise density, as suggested by Berry et al. (1979): burrows and total adjusted sign (TAS - this terminology was suggested by Biosystems Analysis Inc. [1982] after Karl [1981b]; it is also referred to as "adjusted total sign" in Karl [1981b] and "corrected total sign" in Berry et al. [1979]). TAS refers to the total sign minus that sign which occurred with other sign (e.g., a tortoise in a burrow is one sign, not two).

In order to estimate tortoise density from transect sign, sign levels from each of several transects on five study plots, four in Nevada (Burge and Bradley, 1976; Karl, 1979a,b, 1981a) and one 15 mi west of the Nevada border (Karl, 1978) were compared to the previously estimated tortoise densities at each study plot (Table 1) using a linear regression analysis (Figure 1). From the analysis, an index was established in which sign located at each transect site could be converted to estimated tortoise density (Table 2). Similarly, Berry et al. (1979) employed a "modified" linear regression, which involved the removal of four outliers from the calculation.

Broad categories of estimated tortoise density, with divisions at 50 tortoises/mi^2 intervals, were used rather than narrower divisions, in accordance with Berry et al. (1979). I concur with these broad divisions because of the inexact nature of collecting and analyzing the data. Not only was there merely a single transect per site, resulting in a potentially inaccurate estimate of the tortoise density at a site (note the inter-transect variation in the number of sign at all sites in Table 1), but the index formulated (Table 2) is based on estimated, not absolute, densities at the study sites. A distinction was made between 0-10 and 11-50 tortoises/mi^2 to delineate areas with potentially no tortoises and those with tortoises; this division was derived from the regression analysis. An additional category of 1-10 tortoises/mi^2 was utilized for those transects in which no sign was found, but near which sign was sighted by me or reported by BLM personnel.

Each transect was assigned a tortoise density based on TAS and burrow sign. However, transects with questionable sign (e.g., transect no. 94) or where the density category indicated by the TAS was in disagreement with that indicated by the burrow sign total (e.g., transect no. 120) were estimated from surrounding transects or included in both density classes indicated by the two sign categories.

To map areas within which tortoise densities were estimated to be uniform, polygons were drawn around singular transects or groupings of transects with the same estimated tortoise density, midway to transects of different estimated densities, unless there were major distinctions in topography or vegetation. In this case, the polygon line followed the interface between habitat features. Where no obvious distinctions occurred within each polygon, all tortoises densities within the polygon were assumed to be equal. Where a large unsurveyed tract lay adjacent to a transect, the polygon line was drawn approximately two miles from the transect, into the unsurveyed area.

Unsurveyed land above 4000 feet, in known blackbush (Coleogyne ramosissima) or pinyon-juniper (Pinus monophylla - Juniperus osteosperma) communities or along river bottoms was assumed to have no tortoises, based on the result that little evidence of tortoises was found outside the creosote bush (Larrea tridentata) community and that 4000 ft was identified as the approximate elevational limit to creosote bush (see Study Area, below); it is also assumed that tortoises do not swim. Similarly, surveyed areas with no sign were speculatively divided into 0 tortoises/mi^2 and 0-10 tortoises/mi^2 on the basis of the vegetational community. Where creosote bush was uncommon, tortoise densities were estimated to equal 0 tortoises/mi^2; they were estimated to equal 0-10 tortoises/mi^2 in the creosote bush community or creosote bush-blackbush ecotone.

Disturbances at each site (e.g., roads, grazing, off-road-vehicle use, mining, housing) and the aspect dominant flora (i.e., the conspicuous species, estimated by the relative degree of cover and frequency) were estimated visually. The shrub layer vegetation was mapped from these

Table 1. Tortoise Sign on Multiple Transects at Study Plots of Previously Determined Tortoise Densities.

Location of Study Plot	Estimated Tortoise Density (#/mi^2)	Transect Number	Tortoise Sign	
			Burrows	TAS
Shadow Valley, CA* (Karl, 1978)	50	174	4	7
		173	6	6
		172	7	7
Piute Valley, NV (Karl, 1979a)	125	110	10	11
		111	4	7
		112	12-13	13-14
**		1	16-18	17-19
		2	12-16	14-18
		3	8-9	8-9
		4	14-18	15-19
		5	13-18	14-19
		6	8-11	10-13
Sheep Mountain, NV (Karl, 1979b)	50	197	3	5
		203	2-3	2-3
Arden, NV (Burge and Bradley, 1976)	100***	192	3-4	4-5
		193	4-5	6-7
		194	2-3	4-5
		195	3-5	6-8
		196	10	19
Last Chance, NV (Karl, 1981a)	10	5	2-4	2-4
		6	3	6
****		1	0	0
		2	0	0
		3	3-4	4-5
		4	1	1
		5	2	3
		6	0	1

* - Transects walked during employment with California Department of Fish and Game in November, 1978.

** - Transects walked during employment with Biosystems Analysis, Inc Inc., during August, 1981.

*** - Burge and Bradley (1976) estimated the density to be 114 tortoises/mi^2. Because of increased urbanization since that time and the fact that the transects used for the analysis were adjacent to, not on, the study site, an estimate of 100 tortoises/mi^2 was used.

**** - Transects walked during population study on the site.

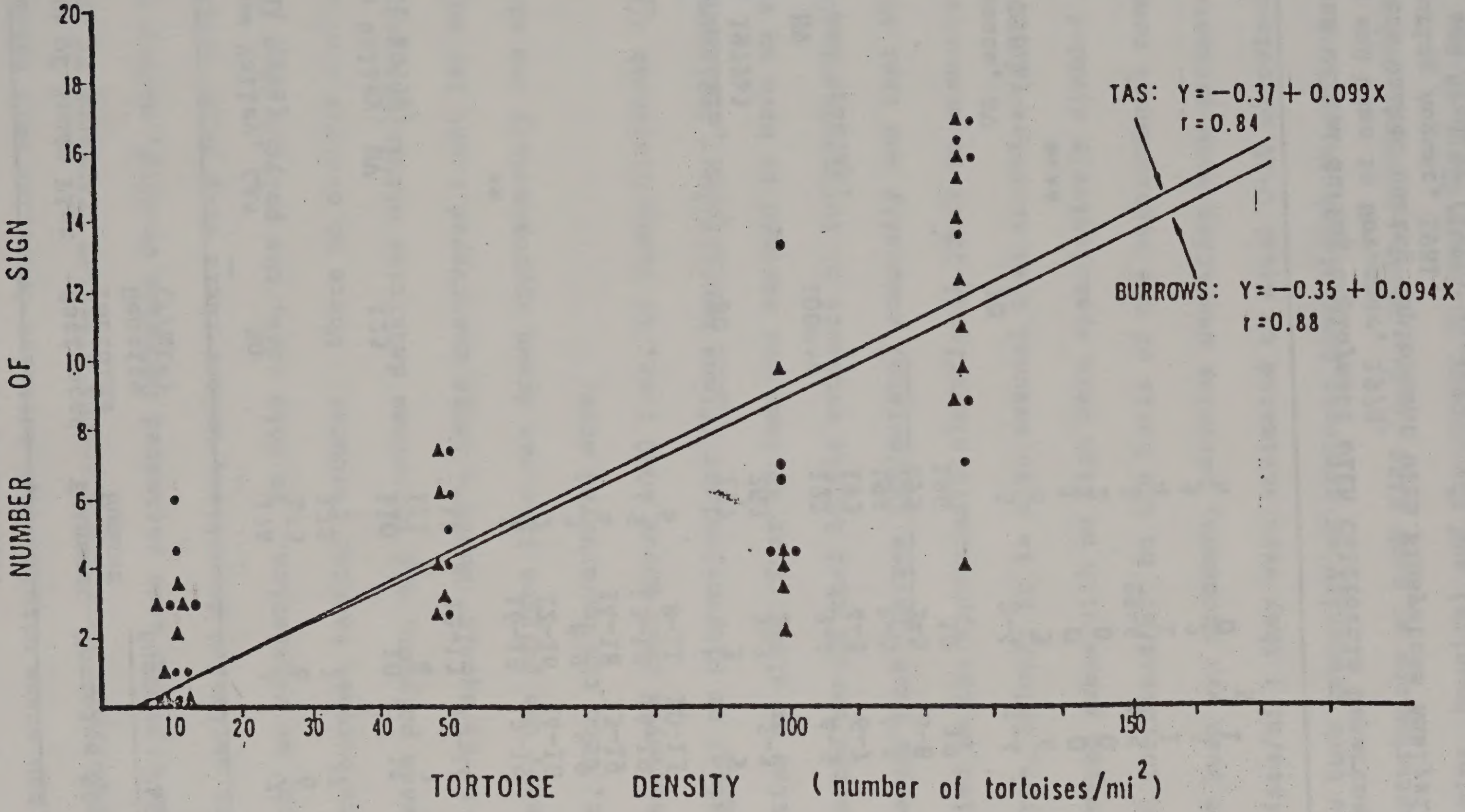

Figure 1. Transect sign from multiple transects on six study plots, correlated to estimated tortoise density on each plot; (▲) = burrow sign, (●) = TAS.

Table 2. Tortoise Densities Estimated from Sign Observed on Transects.

Burrows		TAS		
# Burrows	Estimated # Tortoises/Mi^2	# Sign	Estimated # Tortoises/Mi^2	
0	0-10	0	0-10	very low
1-4	11-50	1-4	11-50	low
5-9	51-100	5-9	51-100	mid
10-13	101-150	10-14	101-150	high
14-18	151-200	15-19	151-200	
>19	≥ 201	> 20	≥ 201	

observations, with supplemental data from the Las Vegas District Office of the BLM, Beatley (1976), and the Nevada Division of Water Resources (1971). Soil consistence and texture were assessed similarly and described in USGS (1961) terms. No quantitative measurements were collected on these parameters. However, data on cattle, sheep and domestic horse grazing from 1967 to 1979 were supplied by the BLM, Las Vegas District. The topography of each site was described and the slope and aspect were computed from appropriate 1:650,000 or 1:25,000 USGS topographical maps. A representative photograph of each site was taken.

To formulate associations between shrub layer vegetation and estimated tortoise densities, a chi square contingency table was used. To determine associations between elevation and estimated tortoise density a Student's t-test was used.

STUDY AREA

Location. The surveyed area comprised 3700 square miles (104 townships) from the Lincoln County border south and east to the state border and west to the Nye County border, omitting the Desert National Wildlife Range (Figure 2).

Vegetation. The creosote bush-bursage community (*Larrea tridentata*-*Ambrosia dumosa*) community is common up to elevations of approximately 4000 feet. Blackbush (*Coleogyne ramosissima*) enters the shrub layer at about 3300 ft, with the creosote bush-blackbush ecotone extending to about 4300 ft. The blackbush community is the dominant community above approximately 4000 feet.

Commonly-associated species in the creosote bush-bursage community include globemallow (*Sphaeralcea ambigua*), winterfat (*Eurotia lanata*), turpentine-broom (*Thamnosma montana*), little-leaf rattany (*Krameria parvifolia*), Mormon tea (*Ephedra nevadensis*), silver cholla (*Opuntia echinocarpa*), Anderson thorn bush (*Lycium andersonii*), indigo bush (*Dalea fremontii*), Mojave yucca (*Yucca schidigera*), Joshua tree (*Y. brevifolia*) and the perennial grasses, rice grass (*Oryzopsis hymenoides*), big galleta (*Hilaria rigida*), bush muhley (*Muhlenbergia porteri*), needle and thread (*Stipa* sp.), and three-awn (*Aristida* sp.). Perennial grasses are very common in Kane Springs Valley and north of the Mormon Mountains.

Commonly-occurring species in the blackbush community include Joshua tree, Mojave yucca, Spanish bayonet (*Y. baccata*), buckhorn cholla (*Opuntia acanthocarpa*) and turpentine-broom. Occasional species are little-leaf rattany, Mormon tea, big galleta, threeawn, and haplopappus (*Happlopappus linearifolius*).

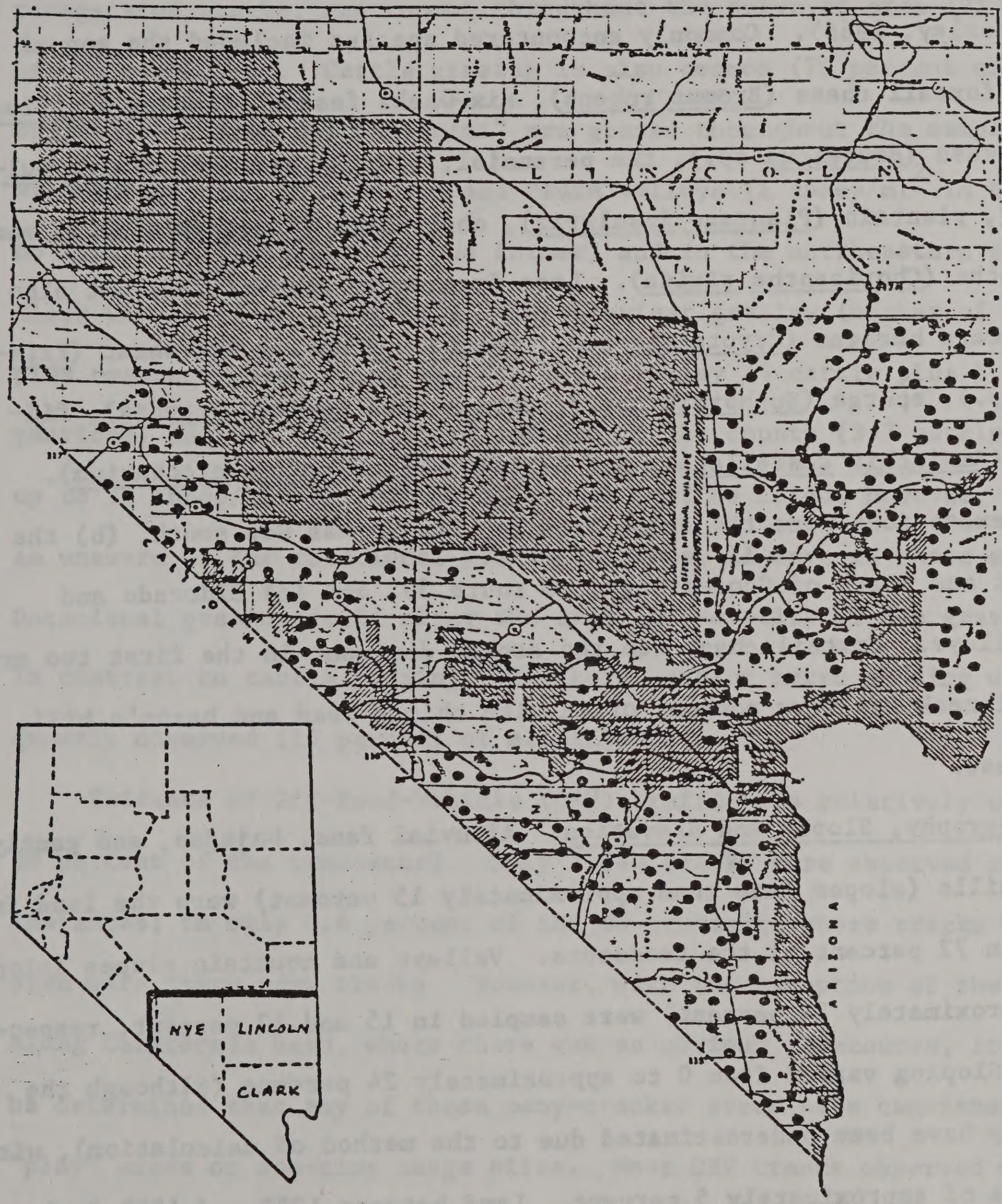

Figure 2. Transect sites (•) to determine the distribution and estimated densities of *Gopherus agassizi* in Nevada. Shaded areas are private (///) or state and federally controlled parks, forests, defense, and recreation (\\\) lands.

Difficulty was encountered in assessing the density and composition of the understory vegetation (herbaceous perennials and annuals less than about 15 cm in height). Annual variability in the germination and survival success of winter annuals occurs in response to annual variation in rainfall (Beatley, 1966). Commonly encountered species included the annual grasses foxtail chess (Bromus rubens), six-weeks fescue (Festuca octoflora) gramma grass (Bouteloua sp.), the perennial, fluff grass (Erioneuron pulchellum), plantain (Plantago insularis), chaenactis (Chaenactis sp.), and chorizanthe (Chorizanthe rigida). Less frequently encountered, but also common, were borages (Cryptantha spp., Pectocarya spp.), buckwheat (Eriogonum spp.), spurge (Euphorbia spp.), chinch weed (Pectis papposa), fiddleneck (Amsinckia tessellata), and heron's bill (Erodium cicutarium). Notable exceptions were the areas from (a) St. Thomas Gap south, (b) the land west and north of Goodsprings, to route 39, and (c) Eldorado and Piute valleys. Foxtail chess was the aspect dominant in the first two areas and fiddleneck was very common, often with chinch weed and heron's bill, in the last.

Topography, Slope, and Elevation. Alluvial fans, bajadas, and gently rolling hills (slopes less than approximately 15 percent) were the land forms sampled in 72 percent of the transects. Valleys and mountain slopes (slopes up to approximately 24 percent) were sampled in 15 and 13 percent, respectively. Sloping varied from 0 to approximately 24 percent (although the latter may have been underestimated due to the method of calculation), with an average of approximately 5 percent. Land between 1320 and 4880 ft in elevation was surveyed; the average elevation was approximately 2600 ft.

Substrate. The soil appeared friable (loose to hard, with slightly hard soil most commonly encountered) in all locations. However, friability decreases along and adjacent to mountainsides due to dense layers of coarse gravel, cobbles and/or boulders. Owing to the infrequent occurrence of transects here, coarse particles generally consisted of fine gravel.

Disturbance. Seldom-travelled dirt roads, often little more than revegetated tracks, are common throughout the surveyed area (75 percent of the transects). Cattle grazing is also common (78 percent of the transects). From 0-4 cattle/mi^2 are grazed thouughout the sampled area, with sheep added in Eldorado and Piute valleys (1 sheep/mi^2 in the latter; no data were available for the former) and in the northeastern portion of Clark County (2-35 sheep/mi^2). The heaviest grazing (number of head/mi^2 plus season of use) is in eastern Piute Valley (4 cattle plus 1 sheep/mi^2, yearlong) and the northeastern portion of the county (3-7 cattle/mi^2 and up to 35 sheep/mi^2 in the spring). (It must be noted, however, that I am unaware of the rotational grazing systems, if any, in these areas. Rotational grazing could alter the apparent severity of the grazing.) In contrast to cattle grazing, wild horse and/or burro grazing was infrequently observed (10 percent of all sites).

Evidence of Off-Road-Vehicle (ORV) traffic was relatively common (in 39 percent of the transects). Only a few tracks were observed in most instances; in only 4.4 percent of the 80 transects where tracks were seen were there many tracks. However, with the exception of the two sites along California Wash, where there was an obvious racecourse, it could not be determined that any of these many-tracked areas were consistently used "play" areas or one-time usage sites. Most ORV tracks observed were made by motorcycles.

Other on-site disturbances included small-scale mines, lightly-travelled dirt roads, bulldozing, and railroads, each present in less than 4 percent of the transects.

Private land in Clark County is concentrated around Las Vegas and along the Muddy and Virgin rivers (Figure 2), totaling approximately 500 mi^2. State and federally controlled forests, parks, and recreation areas total approximately 1025 mi^2. The Desert National Wildlife Range the Nevada Test Site, and the Nellis Bombing and Gunnery Range occupy 4400 mi^2.

RESULTS AND DISCUSSION

Range and Relative Densities

Evidence of tortoises extended to all boundaries of the survey (App. II) Most of the area surveyed (86 percent) was estimated to have tortoise densities less than 50 tortoises/mi^2 (Table 3). Within the county (including surveyed and unsurveyed areas) there are an estimated 4900 mi^2 of suitable tortoise habitat (i.e. land below 4000 ft in elevation or within the creosote bush community and not including urbanized areas [from "Habitat Associations", below, and Karl, 1983a and b]).

Berry et al. (1979) estimated that 50 tortoises/mi^2 and possibly up to 100 tortoises/mi^2 may be unable to survive without adjacent high density populations (with ≥200 tortoises/mi^2) because of the potentially low number of reproductively active females. Proximate high density populations would serve as "nurseries", supplying the surrounding lower density populations with young tortoises. There are nine areas where densities are estimated to exceed 50 tortoises/mi^2: Hidden Valley, Dry Lake Valley, Moapa Valley, the Virgin Mountains, Eldorado Valley, Piute Valley, Goodsprings Valley, Arden, and south of the Spring Mountains, near Pahrump (Appendix II). A description of each area follows:

Table 3. Proportion of Each Estimated Tortoise Density Class in Clark County.

Estimated Tortoises/Mi^2	Number of Transects	Percentage of All Transects	Estimated Area Occupied by Each Density Class	
			Mi^2	% of Total
0, 0-10*	53	26.3	970	26.3
1-10	17	8.5	205	5.5
11-50**	104	51.7	2005	54.2
11-100	3	1.5	70	1.9
51-100***	16	8.0	290	7.8
51-150	2	1.0	40	1.1
101-150****	6	3.0	120	3.2
150	0	0	0	0
Total	201*****	100.0	3700	100.0

* - Approximately 15 mi^2 (1 transect) may have densities reaching 50 tortoises/mi^2.

** - Approximately 45 mi^2 (3 transects) may have densities equalling 100 tortoises/mi^2.

*** - Approximately 30 mi^2 (2 transects) may have densities as low as 11 tortoises/mi^2.

**** - Approximately 15 mi^2 (1 transect) may reach densities of 200 tortoises/mi^2.

***** - Multiple transects at Sheep Mountain and Piute Valley were excluded from the calculation.

1) Hidden Valley - This area of high tortoise density (51-100 tortoises/mi^2) comprises approximately 50 mi^2. It is situated in a

narrow valley, bounded on the west by the Las Vegas Range and on the east by the Arrow Canyon Range, both exceeding 4000 ft in elevation. There are open corridors to the north and south, providing connections to the Coyote Springs and Dry Lake valleys populations, respectively.

At the northern exit of the valley, density estimates are 1-10 tortoises/mi^2, increasing to 11-50 tortoises/mi^2 near Highway 7. At the southern tip of the valley, density estimates vary from 1-100 tortoises/mi^2 and may reach 150 tortoises/mi^2 at the junction with Dry Lake Valley.

Highway 93 intersects this area and there are a few seldom-used dirt roads and very slight ORV use. Cattle are grazed (199 AUM's) on approximately 20 mi^2 of this area, in the spring and fall.

2) Dry Lake Valley - The high density portion of this area (101-150 tortoises/mi^2) encompasses approximately 30 mi^2. The area is open in all directions to tortoise habitation, although low mountains lie to the south-southeast and may present a barrier to tortoise movement.

Densities in excess of 11 tortoises/mi^2 primarily surround the area; however, transects to the southsoutheast showed no sign and those to the west were estimated to have 1-10 tortoises/mi^2.

The major impacts here are from Interstate Hwy. 15, which bisects the area, and dirt bike use. The Las Vegas Mint 400 race begins here and I observed a swath of tracks approximately 40 yds wide. Cattle and some horses are gazed throughout the area (107-207 AUM's), primarily in the spring, although about 15 mi^2 are also grazed in the fall.

3) Moapa Valley - This high density area (51-100 tortoises/mi^2) comprises

about 50 mi^2 and is surrounded by populations estimated to have 11-50 tortoises/mi^2. The approximately 350 mi^2 of habitable land is primarily limited to northerly directions, although the Mormon Mts. are probably uninhabited by tortoises because of their high elevation (primarily over 5000 ft) and consequent vegetation (pinyon-juniper woodland). The Virgin and Muddy rivers, agricultural development and urbanization along these rivers, and Interstate Hwy. 15 probably effectively block any connection between this population and high density populations to the south.

Highway 7, two graded dirt roads, and a railroad (adjacant to one of the dirt roads) traverse the area. Only slight ORV use was observed. Approximately 80 percent of the area is grazed by cattle and some horses in the spring (107-779 AUM's; the higher figure applies to 60 percent of the area).

4) The Virgin Mountains - This high density section comprises approximately 70 mi^2. It is isolated from the north and west by the Virgin River and Lake Mead, respectively, and land is lost to agricultural development along the shores of these bodies of water. To the south, a block of 10 transects had no evidence of tortoise habitation, which may be due to the mountainous terrain and elevations over 4000 ft. The Colorado River lies south of these mountains. Available tortoise habitat in the Nevada portion of the Virgin Mts. area approximates 200 square miles. However, open land is available to the east, in Arizona, where an additional 250 mi^2 of potentially suitable tortoise habitat is available.

Densities in the area range from 51-150 tortoises/mi^2. The majority of the surrounding populations (with the exception of the area to thesouth) are estimated to have 11-50 tortoises/mi^2. Hohman and Ohmart (1979) estimated that the proximate population in

Arizona has from 40-50 tortoises/mi^2.

The major impact is a 100 percent overlap in grazing; 70 percent of the area is grazed by 1397-2730 AUM's of cattle in the spring, summer, and fall. The remainder is grazed in the spring and fall by 317 cattle and horse AUM's and 428 sheep AUM's. Only one very lightly travelled dirt road (paved in part) supplies access to this area from Arizona or Riverside. ORV use was rarely observed.

5) Eldorado Valley - One transect (influencing approximately 15 mi^2) was estimated to have 51-100 tortoises/mi^2. Most surrounding populations are estimated to have 11-50 tortoises/mi^2, although several transects are estimated to have 1-10 or 0-10 tortoises/mi^2. Potentially suitable tortoise habitat extends north to Boulder City, west to the Eldorado Mts. and east to the McCullough Range. An open corridor extends south to the Piute Valley population. South to Searchlight, there are approximately 350 mi^2 of tortoise habitat.

Highway 95 bisects the area and there is a large transmission line with an accompanying access road. Cattle are grazed on a yearlong basis (1849-2947 AUM's); sheep grazing began in 1980. Only slight ORV use was observed.

6) Piute Valley - This is the largest high density area (51-150 tortoises/mi^2) observed, encompassing approximately 135 mi^2. It is bordered to the southeast, west and northwest by areas estimated to contain 11-100 tortoises/mi^2. To the east, the territory was unsurveyed, but it is mountainous in the southern portion (although ~~it generally remains below 4000 ft in elevation~~), thus probably providing little suitable tortoise habitat; in the northern portion

of the unsurveyed area, the terrain is gentle and high densities may extend east to the Colorado River. To the south, into California, density estimates range from 20-200 tortoises/mi^2 (Berry et al., 1979).

Topographically, the limits to tortoise habitat in the valley include the McCullough Range and New York Mountains to the west and the Newberry Mts. and Colorado River to the east. There are approximately 325 mi^2 of potentially suitable tortoise habitat in the valley.

With the exception of Arden, this area has the greatest relative human related impacts of all of the high density areas. Highways 95 and 68 intersect it and most applications to the BLM for motorcycle permits are requested for this area (Mark Maley, personal communication). Additionally, three major power line corridors cross the area. Grazing occurs yearlong and ranges from approximately 1849 cattle AUM's in 30 percent of the area, to 5986 cattle AUM's in 30 percent, and 1200 cattle AUM's plus 1209 sheep AUM's in 40 percent. Private land comprises approximately two percent of the area.

7) Goodsprings Valley - This area has from 101-150 tortoises/mi^2 and comprises approximately 15 mi^2. It is very isolated by mountainous terrain over 4000 ft to the south, north, and west and by Hwy. 15 to the east. It is slightly open to the northeast toward Arden. North to the southern tip of the Bird Spring Range, there are about 70 mi^2 of potential tortoise habitat. Surrounding density estimates range from 0 to 1-10 tortoises/mi^2.

In addition to Hwy. 15, disturbance includes the paved Goodsprings Road and cattle grazing. The current grazing allotment permits 174 AUM's on a yearlong basis; however, there has been no grazing since

1975. No ORV use was observed.

8) Arden - The high density transects here (indicating 51-200 tortoises/ mi^2) occupy approximately 50-75 mi^2. This area is open only to the south where transects indicated 11-50 tortoises/mi^2. It is bounded on the west by mountainous terrain over 4000 ft and on the east by expanding urban development from Las Vegas. Twenty-five percent of this high density area is currently under private ownership. Aside from the encompassing urbanization, this area is heavily impacted by dirt trails and roads and by ORV use. No grazing occurs in the area.

To the southern end of the Bird Spring Range, there are potentially 160 mi^2 of suitable tortoise habitat (excluding private land, although it does not necessarily preclude tortoise habitation).

9) Pahrump - This area comprises approximately 15 mi^2. Density estimates are 51-100 tortoises/mi^2/ Transects to the east and southeast resulted in density estimates of 11-50 tortoises/mi^2; 1 transect due south indicated 0-10 tortoises/mi^2. Transects were not walked to the west or northwest, in Pahrump Valley, because of the large tract of private land there (approximately 125 mi^2). The Spring Mts., which lie directly north and surround the valley to the east and southeast, precluded sampling land north of the site. Within the valley and excluding private land, there are approximately 240 mi^2 of potentially suitable tortoise habitat.

Hwy. 16, the main route from Las Vegas to Pahrump, traverses this area. Additionally, cattle are grazed throughout this area during the spring, summer, and fall (1251 AUM's). No evidence of ORV use was observed.

Habitat Associations

Vegetation. Tortoise sign was found primarily in the creosote bush community (95 percent of the 132 sites where definite tortoise sign was located on or near the transect); however, evidence of tortoises was also found in the creosote bush-blackbush ecotone (3 percent) and in the blackbush community (1.5 percent).

Estimated tortoise density appears to be negatively correlated with the aspect dominance of blackbush (Table 4), although statistical significance could not be established because of the low number of transects in the blackbush community and blackbush-creosote bush ecotone. No transects where blackbush was the aspect dominant and only four transects in the ecotone were estimated to exceed 10 tortoises/mi^2.

Table 4. Shrub Layer Community Compared to Estimated Tortoise Density; C = creosote bush, B = blackbush, C/B = creosote bush-blackbush ecotone, E = expected value, and 0 = observed value.

Estimated Tortoises/Mi^2	Shrub Layer Community		
	C	C/B	B
0, 0-10	E=47 0=43	E=2 0=3	E=1 0=4
1-10	E=16 0=14	E=1 0=2	E=0 0=1
11-50	E=76 0=80	E=3 0=1	E=2 0=0
51-100	E=13 0=14	E=1 0=0	E=0 0=0
101-150	E=5 0=5	E=0 0=0	E=0 0=0
Total	156	6	5

Note: Transects which could not definitely be included in one of the density classes listed above were not included in the analysis.

The result that estimated tortoise densities appear to decrease with the addition of blackbush as a major component of the shrub layer is probably a function of the climatic constraints associated with this species. Beatley (1976) stated that the climatic difference between the creosote bush and blackbush communities is the amount of precipitation. Blackbush enters the creosote bush community where the mean annual rainfall reaches 6.4 inches and creosote bush is absent at annual precipitation levels exceeding 7.2 inches. Munz (1959) and Tidestrom (1925) both stated that the climatic difference between these communities is that of lower temperatures in the blackbush community (a minimum of -5.5°C and 130 frost-free days compared to a minimum of -1.1°C and 190 frost-free days in creosote bush). Because I observed blackbush as low as 2880 ft, but only on north-facing slopes at this low elevation, it follows that temperature, not precipitation, is probably the major climatic feature governing the distribution of this species. It is possible that the increased precipitation, lower temperatures, community composition, and/or the amount of cover associated with the blackbush community has an adverse effect of _G. agassizi_, resulting in reduced densities in this community.

Although tortoise sign was found where foxtail chess appeared to be dominant (i.e., few other obvious species and often densely carpeted), over half (56 percent) of the 25 transects where foxtail chess was the understory aspect dominant had no tortoise sign. Also, only 7 percent of these 25 transects occurred where tortoise densities were estimated to exceed 50 tortoises/mi^2. This apparent negative correlation is consistent with that found for Lincoln and Nye counties (Karl, 1983a) and for the combined data from all three counties (Karl, 1983b).

Topography, Slope, and Elevation. Evidence of tortoises was found on all land forms and along all slope steepnesses sampled. However, only one transect with an estimated density greater than 50 tortoises/mi^2 occurred on a mountain slope (where the steepness was estimated to be approximately 12 percent). No transects with tortoise density estimates in excess of 100 tortoises/mi^2 occurred on a mountain slope.

Tortoise sign was primarily found below 3600 ft (96 percent of the 140 transects where sign occurred), although it occurred as high as 4560 ft. (1 transect, in the 1-10 tortoises/mi^2 class). The mean elevation of transects with sign was 2650 ft. Although the upper limit of the elevational range was higher in transects with lower tortoise density estimates (Table 5), there was no significant difference between the mean elevation for each density grouping ($p > .05$ for all pairwise comparisons).

Table 5. Comparison of Estimated Tortoise Density Classes to Elevation.

	Estimated Tortoise Density (# Tortoises/Mi^2)				
	0 0-10	1-10	11-50	51-100	101-150
Mean Elevation (ft)	2885	2842	2582	2689	2506
Standard Deviation	863	767	631	447	321
Range	1500-4880	1640-4560	1320-4040	1800-3280	2200-3050
n	52	17	81	14	5

The present study does not establish an elevational limit to tortoise habitation. However, two factors might set the limit at approximately 4000 ft. First, estimated tortoise densities appear to decrease with a decrease in the aspect dominance of creosote bush, which finds its upper limit at approximately 4000 ft. Second, tortoise sign was found in only two of the transects over 4000 ft. Karl (1983b) also suggested that 4000 ft was the approximate elevational limit to tortoises for Clark, Lincoln and Nye counties combined.

Substrate. Tortoise sign was found on all substrates sampled. However, loose soils, cobbles, boulders, and dense coarse gravel only occurred where tortoise densities were estimated to be less than about 75 tortoise/mi^2.

Because the friability of soil on upper bajadal slopes is decidedly less than that on lower slopes and in valleys, one might speculate that tortoise densities would decrease on the former because of burrowing difficulties. However, assessments of substrate consistency were too imprecise to be compared quantitatively to estimated tortoise density.

Disturbance. Seldomly-used dirt roads were present in 66 percent of the transects with tortoise sign, cattle grazing in 49 percent, and ORV use in 35 percent. Horse and/or burro grazing, sheep grazing, mining, and railroads were each present in less than 11 percent of these transects. Any analysis of the effects of individual disturbances on tortoises is impossible in this paper because of the lack of controls and lack of knowledge regarding the current and historical intensity of the disturbances. However, if the inverse correlation of foxtail chess (a grazing-introduced annual [Robbins et al., 1951]) to tortoise density is real, it may also be indicative of the long-term impacts of grazing on the desert tortoise. A dominance of foxtail chess suggests extensive grazing, either temporally or spatially, Although foxtail chess is eaten by desert tortoises, its palatability or nutritive value may be less than that of native annuals or perennials, which may be competitively excluded by the exotic species (with the aid of selective grazing). The subsequent result might be an adverse effect on reproduction and survivability of G. agassizi (see Karl, 1983b, for a thorough examination of this situation).

CONCLUSIONS

Tortoise sign was found throughout the surveyed area. Total estimated habitat area is 4900 mi^2 within the boundaries of the survey. Estimates for 86 percent of the area suggest that tortoise densities are less than 50 tortoises/mi^2. Of the nine areas with estimated tortoise densities from 50-200 tortoises/mi^2, the Pahrump, Goodsprings Valley, Dry Lake Valley, and Eldorado Valley populations may occupy too small an area (i.e. have too small a population) to survive. Additionally, several factors may contribute to the extinction of these populations. The urban expansion of Pahrump may force tortoises there to move further south into the valley. Although land is available for expansion, the low tortoise densities currently estimated for the valley may be indicative of sub-optimal habitat. Goodsprings is topographically isolated, except to the north, towards Arden. However, this offers no refuge, as the Arden population will surely be destroyed by urban expansion from Las Vegas. The Dry Lake Valley population, while connected to the Hidden Valley population, will probably be lost due to fragmentation by Interstate Hwy 15 and disturbance, as well as to its small size. Only the Eldorado Valley population, which has an open corridor to the high density Piute Valley population, and potentially adequate reserves of available tortoise habitat, may be viable.

The Virgin Mountains, Piute Valley, Hidden Valley and Moapa Valley populations are probably the most viable by virtue of their size, lack of disturbance and/or amount of available tortoise habitat. However, current and pending land uses and their effects on these populations must be carefully monitored and controlled to insure their survival.

Precise determinations of tortoise habitat are impossible with the present data, but the data suggest that tortoises are found primarily in the creosote bush community, below 4000 ft. Additionally, extensive livestock grazing may have an adverse effect on tortoises as a result of vegetational changes.

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Appendix I. Sign Located on Transects.

Appendix . Sign located on Clark County transects

Transects No.	Legal Description	Burrows	Individual Sign		Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/mi^2
			Scat	Skeletal Remains				
1	T16S R63E S29,30			1			1	1-10
2	T15/16S R63E S33/4	2-5		1	1		2-5	51-100
3	T15S R63E S20	4-5	1	1	1		5-6	51-100
4	T15S R63E S3	0-1					0-1	0-50
5	T14S R63E S20,21,29	0		1			1	1-10
6	T14S R63E S3,4	1					1	0-50
7	T13S R62E S6						0	0-10
8	T13S R63E S23,24	3					3	11-50
9	T13S R64E S22,26,27						0	0-10
10	T13½/14S R63E S33/4	3					3	11-50
11	T13S R64E S7	3					4	11-50
12	T13S R65E S31	1-3			1		1-3	11-50
13	T14S R65/66E S13/18	5-6	2	2	1	Tracks 1	8-9	51-100
14	T14S R65E S17						0	0-10
15	T13S R65E S1	1-2					1-2	11-50
16	T14S R66E S23	1	1				2	11-50

Appendix , continued

Transects No.	Legal Description	Burrows	Individual Sign Scat	Individual Sign Skeletal Remains	Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/mi^2
17	T14S R66E S3,4	1-2					1-2	11-50
18	T14S R67E S7	3		1	1		4	11-50
19	T13S R67E S8	1		1			2	11-50
20	T13S R66E S36	1-3			3		4-6	51-100
21	T13S R68E S4	4				Tracks 1	4	11-50
22	T13S R69E S5	1-2					1-2	11-50
23	T13S R69E S14,15,23						0	0-10
24	T13S R67E S23,26	8	7				9	0-10
25	T13S R68E S21,28	8-9	1				8-9	51-100
26	T14S R67E S23,26	2	1			Tracks 1	2	11-50
27	T13S R66E S29,32	3					3	11-50
28	T15S R69E S12	5-6	7		2			51-100
29	T15S R69E S15,22	0-1					0-1	0-50
30	T16S R69E S1,2	3-4			0-1	1	3-4	11-50
31	T16S R69E S21						0	0-10

Appendix , continued

Transects No.	Legal Description	Burrows	Individual Sign Scat	Skeletal Remains	Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/mi^2
32	T16S R70E S21,29	3	2	1			6	11-100
33	T17S R70E S11	8-14	1	1	1	Tracks 1	10-16	101-150
34	T17S R70E S19	0-1					0-1	0-50
35	T18S R69/70E S6,7	2	1				2	11-50
36	T18S R69E S13,14,23,24						0	0-10
37	T19S R69E S1,12						0	0-10
38	T19S R70E S2						0	0-10
39	T20S R70E S12,13						0	0-10
40	T19S R70E S83						0	0-10
41	T19S R69E S22,27						0	0-10
42	T20S R69E S14,23						0	0-10
43	T20S R70E S29,30						0	0-10
44	T19S R69E S32,33						0	0-10
45	T18S R70E S23,26						0	0-10
46	T18S R71E S1,12	4-6	3	4	1		10-12	51-150
47	T16S R70E S13,24						0	0-10
48	T13S R70E S31	3	4			Eggshells 1 Tracks 1	4	11-50
49	T14S R70E S2	1		1			2	11-50

Appendix , continued

Transects No.	Legal Description	Burrows	Individual Sign Scat	Individual Sign Skeletal Remains	Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/mi^2
50	T14S R70E S21,22,16	0-1			1		0-1	0-50
51	T14S R69E S24	1-2					1-2	11-50
52	T13S R70E S6,7			1			1	1-10
53	T14S R69E S4,5						0	0-10
54	T14S R68E S3,4	2					2	11-50
55	T14S R68E S33		1	2			3	1-10
56	T15S R68E S10,11,14						0	0-10
57	T15S R68E S31,32						0	0-10
58	T17S R66E S28,29	0-1		1			1-2	1-50
59	T19S R63E S16,21	1					1	11-50
60	T19S R64E S9	1	1				2	11-50
61	T18S R64E S25,26						0	0-10
62	T18S R65E S8	2	1	2			5	11-50
63	T17S R64E S36	3	2	1	1		6-9	11-100
64	T17S R65E S27	0-1					0-1	0-50
65	T18S R65E S13,14,23,24						0	0-10
66	T19S R65E S1						0	0-10
67	T18S R66E S28,29	0-1	1				1-2	1-10

Appendix , continued

Transects No.	Legal Description	Burrows	Individual Sign		Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/mi^2
			Scat	Skeletal Remains				
68	T19S R66E S2,3	1	1				2	11-50
69	T18S R67E S19						0	0-10
70	T19S R66E S24,25	1	1				2	11-50
71	T18S R67E S33						0	0-10
72	T15S R67E S10,11						0	0-10
73	T15S R67E S20		1				1	1-10
74	T16S R67E S26,35						0	0-10
75	T18S R66E S3						0	0-10
76	T17S R65E S11			2			2	1-50
77	T17S R66E S8			1			1	1-50
78	T16S R66E S15,22	1		2			3	11-50
79	T16S R65E S14,15			1			1	1-50
80	T16S R66E S8,17	3	1		1		5	11-50
81	T15S R66E S29,32	1					1	11-50
82	T15S R66E S15	1	4	2			3	11-50
83	T15S R65E S14	2	1				2	11-50
84	T15S R65E S31,32	0-1					0-1	0-50
85	T15S R64E S10,15	1-2	2	1	1		3-4	11-50

Appendix , continued

Transects No.	Legal Description	Burrows	Individual Sign		Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/ mi^2
			Scat	Skeletal Remains				
86	T15S R64E S20						0	0-10
87	T14/15S R64E S32/5				1		1	1-10
88	T16S R64E S2	3	2	1	1		5	11-100
89	T16S R65E #31,32	3-4	1				4-5	11-50
90	T18S R64E S8			1			3 ?	11-50
91	T16S R64E S17	2		1			3	11-50
92	T17S R64E S16						0	0-10
93	T17S R63E S26	2			1		2	11-50
94	T17S R63E S17	4-5	1	1			5-6	11-100
95	T18S R63E S7,8	2		1			3	11-50
96	T18S R63E S14	9-10	3	2			12-14	101-150
97	T19S R62/63E S6,7/12	2-4		1			3-5	11-50
98	T25S R59$ S17,18	11	1		1	Eggshells 1	11	101-150
99	T25S R59E S35	0-1					0-1	0-50
100	T26S R59E S6,7						0	1-10
101	T27S R62E S29,32						0	0-10
102	T28S R62E S10	1-2					1-2	0-10

Appendix , continued

Transects No.	Legal Description	Burrows	Individual Sign		Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/mi^2
			Scat	Skeletal Remains				
103	T28S R62E S28,33	0-1					0-1	11-50
104	T29S R62E S2	1-2					1-2	0-50
105	T29S R63E S8	0-2					0-2	11-50
106	T29S R62E S28	4-7					4-7	0-50
107	T29S R63E S27,28	1-2	2				3-4	51-100
108	T30S R63E S7,8	8-10	1		3		11-13	11-50
109	T31S R63E S14,15	10	2		1	Tracks 2	11	101-150
110	T30S R63E S34	4	3				7	101-150
111	T30S R63E S34	12-13	2		4	Tracks 2	13-14	101-150
112	T30S R63E S34	2-5	3				4-7	101-150
113	T31S R64E S30	4					4	11-100
114	T32S R64E S14	1-2	1				2-3	11-50
115	T33S R65E S2,3,11	2					2	11-50
116	T32S R66E S8	0-1					0-1	11-50
117	T32S R65E S16						0	0-50
118	T32S R65E S5	3					4	0-10
119	T31S R64E S23,24	2-3	1		3		6-7	11-50
120	T30S R64E S34	2-3	2				3-4	11-100
121	T29S R64E S32	8	7		1		10	11-50

Appendix , continued

Transects No.	Legal Description	Burrows	Individual Sign				Total Adjusted Sign	Estimated Tortoise/ mi^2
			Scat	Skeletal Remains	Live Tortoise	Other		
122	T30S R64E S10,15						0	51-100
123	T28S R63E S20	5	4				9	0-10
124	T28S R64E S30	6-10	8	1	1		9-13	51-100
125	T29S R64E S1,12	0-1					0-1	51-150
126	T28S R64E S5	1-2	3				4-6	0-50
127	T27S R63E S1,12	1-2	3				4-6	11-50
128	T28S R63E S9,10	2					2	11-50
129	T26S R63E S19,20	5-7				Tracks 1	5-7	51-100
130	T26S R63$ S13						0	0-10
131	T25S R64E S32,33		2				2	1-10
132	T25S R64E S7	2					2	11-50
133	T24S R63E S25	1-2	2	1			4-5	11-50
134	T24S R63E S8,17,18						0	0-10
135	T25S R62E S8,17	1					1	11-50
136	T25S R62E S23	1					1	11-50
137	T26S %62E #29,30						0	0-10
138	T26S R62E S3,4,9,10	0-1					0-1	0-50
139	T27S R62E S1, 12	2			1		2-4	11-50
140	T27S R63$ S21	2-4			1		2-4	11-50

Appendix , continued

Transects No.	Legal Description	Burrows	Individual Sign		Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/mi^2
			Scat	Skeletal Remains				
141	T25S R63E S27						0	0-10
142	T25S R63E S8			1			1	11-50
143	T24S R64E S15,16,21,22	0-1		2			2-3	11-50
144	T24S R64E S35	1		2	1		3	11-50
145	T23S R63E S25	0-1					0-1	0-50
146	R23S R63E S19						0	0-10
147	T21S R63E S19	2	1	1			4	11-50
148	T21S R63E S9	2-3	1				2-3	11-50
149	T19S R65E S33,34						0	0-10
150	T20S R64E S11,12	2					2	11-50
151	T20S R64E S21						0	0-10
152	T19S R64E S30	2	2				4	11-50
153	T20S R63E S14,15						0	0-10
154	T20S R63E S20,29,30	1	3				3	11-50
155	T23S R60E S13,14	2					2	11-50
156	T23S R61E S11	3			1		3	11-50
157	T23S R61E S33						0	0-10
158	T24S R61E S27,28	0-1					0-1	0-50

Appendix , continued

Transects No.	Legal Description	Burrows	Individual Sign Scat	Skeletal Remains	Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/mi^2
159	T24S R60E S26,35	1-2	4				4-5	11-50
160	T24S %61E S7,18	1	1		1		2	11-50
161	T24S R60E S18	2	3				5	11-50
162	T23S R59/60E S36/31	1	1				2	11-50
163	T25S R60E S7	1					1	11-50
164	T24S R58E S10,15						0	0-10
165	T23S R58/59E S36/31						0	0-10
166	T24S R58E S35	0-2	1				1-3	1-10
167	T24/25S R13E S35/2	0	1				1	1-10
168	T25S R13E S23						0	0-10
169	T24S R57E S1,2		1				1	1-10
170	T24S R56E S25	2-3	1		1	Tracks 1	2-3	11-50
171	T23S R56E S14	2-5		1			3-6	11-50
172	T23S R56E S30	1-2		1			2-3	11-50
173	T24S R57E S22	1					1	11-50
174	T24S R56E S3						0	0-10
175	T23S R55E S15,16	3-4					3-4	11-50

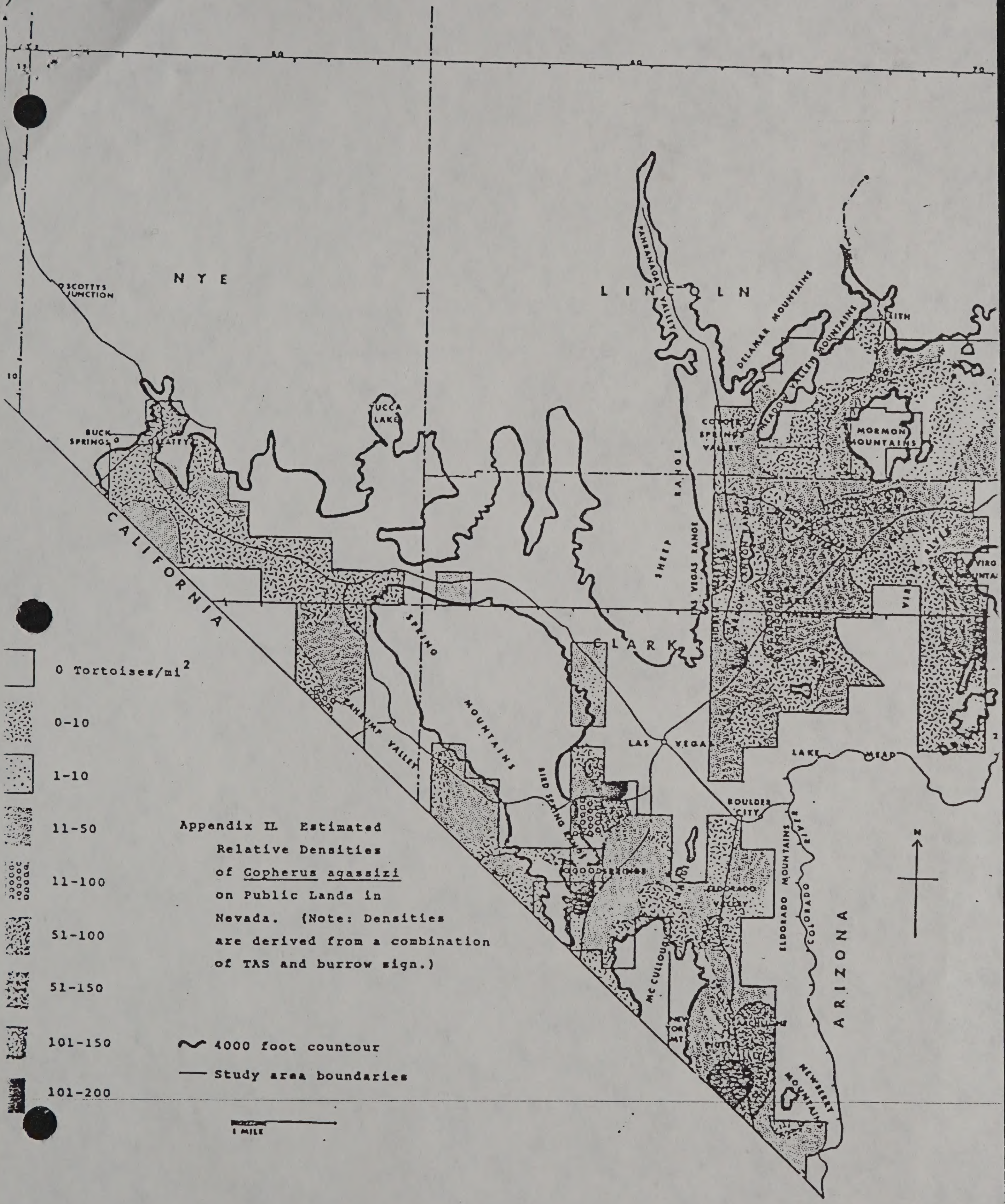
Appendix , continued

Transects No.	Legal Description	Burrows	Individual Sign		Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/ mi^2
			Scat	Skeletal Remains				
176	T22S R55E S3,32						0	0-10
177	T22S R55E S24,25,26	2	1	1			3	11-50
178	T22S R56E S22,28	2		1			3	11-50
179	T22S R56E S5,8	2		3			5	11-50
180	T22S R55E S3	2		1			3	11-50
181	T21S R54/55E S24/19	5		1	1		6	51-100
182	T21S R55E S14,15	0-1					0-1	0-50
183	T16S R55E S7	0-1					0-1	0-50
184	T16S R55E S13	2		1			3	11-50
185	T18S R59E S2,3			1			1	1-10
186	T18S R59E S27,28	2		2			4	11-50
187	T19S R59E S12		3				3	1-10
188	T19S R59E S5,6			1			1	1-10
189	T20S R59E S2	1		1			2	11-50
190	T21S R59E S13,14	3-5	6	1			8-10	51-100
191	T21S R59E S18						0	0-10
192	T22S R59E S3	3-4	1				4-5	11-50
193	T22S R59E S27,28	3-5	2				5-7	11-100

Appendix . , continued

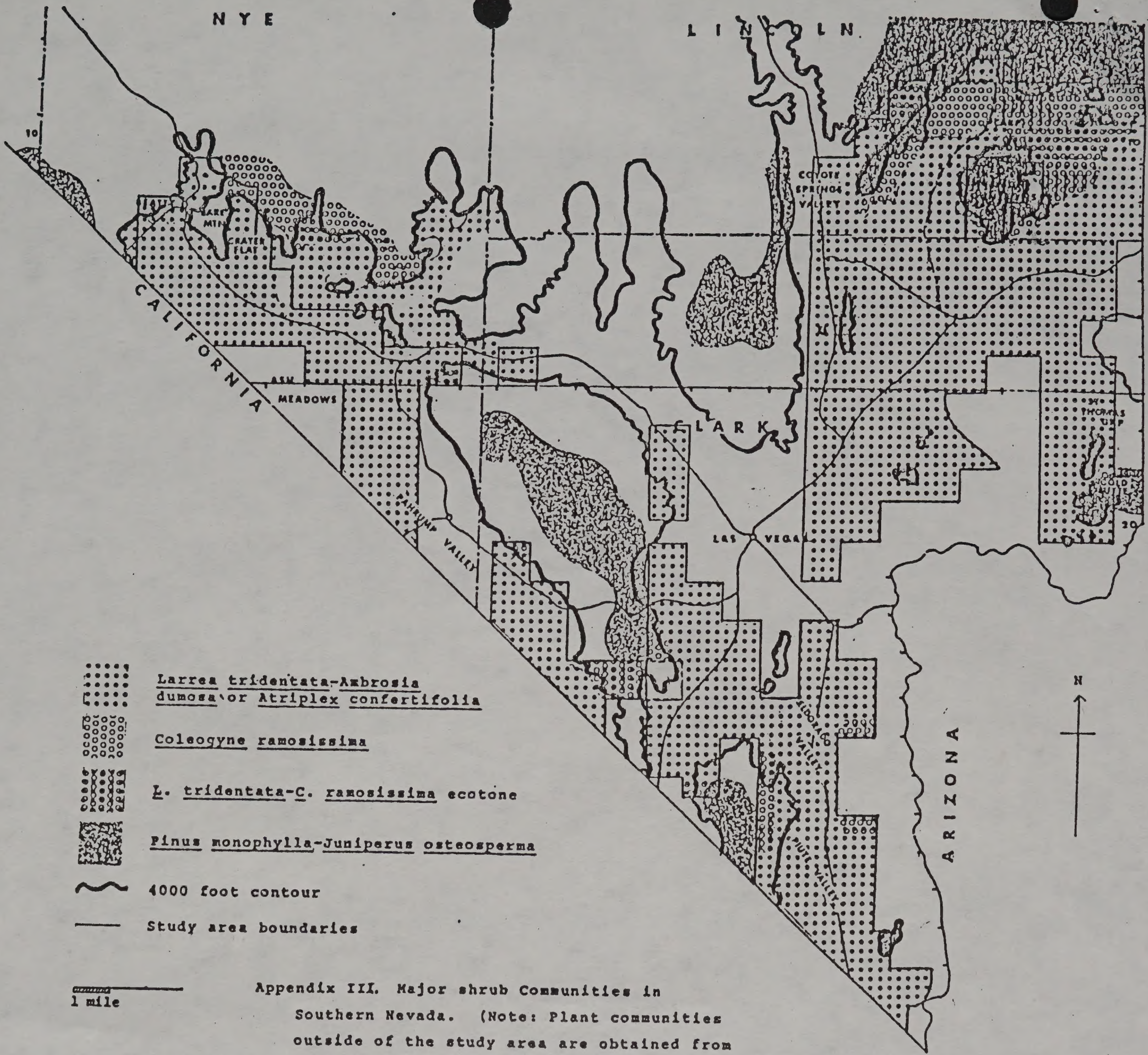
Transects No.	Legal Description	Burrows	Individual Sign Scat	Individual Sign Skeletal Remains	Live Tortoise	Other	Total Adjusted Sign	Estimated Tortoise/ mi^2
194	T23S R59E S10,15	2-3	4				6-7	11-100
195	T22S R60E S30,31	3-5	2	1			6-8	51-100
196	T22S %60E S7,18	10	4				19	101-200
197	T26S R60E S5,6	3	2				5	11-50
198	T27S R60E S4						0	0-10
199	T26S R60E S16,21						0	0-10
200	T26S R60E S1	1-2					1-2	11-50
201	T25S R61E S33,34						0	0-10
202	T25S R61E S17,19,20						0	0-10
203	T25/26S R60E S2532/5	2--3					2-3	11-50
204	T26S R59E S25,26,35,36	1					1	11-50

Appendix II. Estimated Relative Densities and Distribution of _Gopherus agassizi_ in Nevada.



Appendix II Estimated Relative Densities of *Gopherus agassizi* on Public Lands in Nevada. (Note: Densities are derived from a combination of TAS and burrow sign.)

Appendix III. Major Shrub Layer Communities in *Gopherus agassizi* study area in Nevada.



Appendix III. Major shrub Communities in Southern Nevada. (Note: Plant communities outside of the study area are obtained from reports by Beatley, 1976 [for Nye County]; B.L.M.,

Appendix IV. Transect Data Form.